Report on the CURIAS Project (US EPA PPIS Grant # NP0991392-01)

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Office of Technical Assistance for Toxics Use Reduction

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The following report is a summary of work performed under EPA Grant # NP0991392-01 provided through the Pollution Prevention Incentives for States (PPIS) program.

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The Office of Technical Assistance

The Massachusetts Office of Technical Assistance for Toxics Use Reduction (OTA) provides manufacturers and institutions with non-regulatory, confidential assistance on opportunities to reduce the use of toxic materials or generation of toxic byproducts while improving economic competitiveness. The Office offers the following non-regulatory services: free and confidential on-site assessments; conferences and workshops; financial analyses; and written information on toxics use reduction techniques and technologies. For more information about OTA contact: The Office of Technical Assistance, 100 Cambridge Street, Room 2109, Boston, Massachusetts 02202. Phone: (617) 626-1060.

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I. Assisting Schools

This report details the findings of a project carried out by the Massachusetts Executive Office of Environmental Affairs, Office of Technical Assistance for Toxics Use Reduction (OTA) under a $60,000 grant from the U.S. Environmental Protection Agency's Pollution Prevention Incentives for States grant program. In 1995 and 1996, OTA, which provides assistance to toxics users in implementing pollution prevention activities, made 34 onsite visits to public schools in the Commonwealth to assist them in reducing risks from chemical use and improving indoor air quality. The program, called CURIAS (Chemical Use Reduction for the Improved Indoor Air Quality in Schools) was coordinated with EPA's initiative to disseminate its *Tools for Schools* manual, a guide for addressing indoor air and related environmental issues in schools.

OTA's focus has typically been on making onsite visits by invitation to manufacturing facilities, well known sources of toxic pollution. With this grant, OTA was able to do two things: dedicate time to assisting schools, which also use toxic chemicals, and forge a connection between the approach of reducing the use of chemicals and programs to address indoor air quality problems.

Each of the 34 schools visited received recommendations from OTA on how to address the indoor air and chemical use problems identified, and prevent problems from occurring in the future. As we expected, most schools were initially interested in indoor air quality. Although many indoor air quality problems are biological in nature, it is OTA's point of view that no indoor air quality program can be complete without a substantial chemical use reduction component. This is also the approach taken by EPA's *Tools for Schools*, and the onsite visit program confirmed the importance of this, finding many chemical use problems and reduction opportunities.

II. Summary of Results of the Onsite Visits

The offer of onsite technical assistance visits, made at a number of meetings of relevant professionals, quickly generated requests far exceeding the goals of the project. Although this report is not a statistically valid sampling of facilities in the state, the work done through CURIAS provides an indication that schools do need assistance in addressing indoor air quality improvement and chemical use reduction opportunities. Most of the schools visited by OTA had obvious and preventable indoor air quality problems, such as:

- Visible mold and stained ceiling tiles
- Blocked vents
- Ventilation systems that are not maintained
- Unvented photocopiers, duplicating machines, and chemical storage areas
- Nonfunctional fume hoods in science departments

There were environmental compliance problems, such as:

- Improper chemical waste storage and handling
- Photographic chemicals discharged down the drain

Few schools were taking advantage of opportunities for reducing chemical use, such as:

- Implementation of microscale chemistry or low quantity chemical procedures in science labs
- Integrated pest management in buildings and grounds
- Chemical inventory systems, restrictions on purchases of chemicals which become hazardous wastes

During the course of OTA's visits the following was observed:

Chemical acceptance, purchasing, and storage management practices need improvement

Many of the schools have accepted free gifts of chemicals from local companies, assuming that they might be of use, but most often they are simply stored. Once they and other unused chemicals have expired on the shelf, they may be hazardous wastes according to law, and storage beyond prescribed time limits is a regulatory violation. OTA noted unsafe storage practices - such as storing chemicals alphabetically instead of by hazard class - of old waste chemicals from science classes, art, vocational training, and other sources, at the majority of schools visited. Some of these practices are violations of hazardous waste laws. Despite the fact that toxic and flammable chemicals are stored in custodial areas, 70% of the schools had no venting in these areas. Few schools had invested the relatively small amount necessary for converting chemical laboratory experiments to "microscale", which uses greatly reduced quantities of chemicals and has a rapid payback in savings. Few schools had updated inventories of chemicals, which is an inexpensive way of avoiding overstocking and controlling usage.

Opportunities exist for switching to safer maintenance chemicals, such as adhesives, sealants or cleaners, which many of the schools have not implemented. The Massachusetts Right to Know law requires that employees using hazardous chemicals be supplied with Material Safety Data Sheets informing them of the dangers associated with each chemical, but OTA found a low level of understanding and use of this information.

Indoor air quality concerns were common

Only a few schools had an indoor air quality team, recommended by EPA's *Tools for Schools* manual as the primary step in addressing indoor air quality issues in a coordinated manner. High carbon dioxide levels were frequently found, often due to classroom overcrowding, but sometimes due to broken or turned off ventilation. (Some schools were attempting to save on energy and maintenance costs, but some did not seem to be aware of proper ventilation practices). Only two schools had ever cleaned their ductwork. About 40% of the schools visited had visible mold growth and over 80% had ceiling tiles stained from water leaks; none had a maintenance procedure for replacing the tiles to reduce mold growth. Several schools had carpeting over 20 years old, likely sources of dust and allergenic materials.

Special concerns of vocational programs

In addition to the special concerns raised in maintenance and custodial functions, and art and science classrooms, special attention should be paid to vocational shops, which use a wide variety of hazardous materials. These include auto, carpentry, cosmetology, culinary arts, printing, plumbing, electrical, and metalworking, and they all have special hazards for students and staff. Each program represents a critical opportunity for training in safety and relevant environmental issues, which will be of great importance when students enter the workforce.

Some schools have shown what can be done

Some schools had taken steps to eliminate many of their janitorial and maintenance chemicals and had installed bulk dispensing systems which reduce mixing of materials, spills, and air emissions. They also reduce overuse by delivering the precise amount needed. Many (but not most) schools had switched to using biological specimens that were not preserved in formaldehyde. Many schools provided nontoxic paints and glazes for their students, while others were still using the more hazardous solvent-based materials. Most school personnel, although unfamiliar with integrated pest management techniques which reduce the use of chemicals sprayed indoors, were only using pesticides as needed.

Addressing environment, health and safety issues is not institutionalized

All of OTA's visits were initiated by request of school staff, many of whom were eager to implement solutions. Some staff were also eager to integrate environmental education into their classroom activities. With the exception of facility managers, all were taking time from other responsibilities to address issues that had arisen. There are many environmental, health and safety rules that commercial enterprises must follow, that also apply to schools, but schools have not felt the same pressure as industry to observe these requirements because enforcement is rare.

The oft-cited lack of resources; the absence of specific, designated responsibility (no trained environmental health and safety specialists on staff); competition with other priorities, and other factors such as the stress of large classrooms, small budgets, and new initiatives all consistently weigh against a strong institutional investment in addressing health, safety and environmental issues. No school had adopted a full-fledged pollution prevention program.

Neglected problems become acute

Most frequently, OTA's assistance was requested as a result of a need that had become acute because a chronic problem had been neglected for too long. For example, many schools - in fact most visited by OTA - have stored chemicals without regard to their compatibility, or the fact that they can become shock-sensitive over time. On some visits dangerously incompatible chemicals were noted, involving serious explosion and fire risks. On more than one occasion the services of the state police bomb squad were required. In more than one location, authorities (from fire or health agencies) threatened school closure. Thirty years ago it was wise to remove a jar of ether from the classroom. Today, when crystallization may have occurred just under the lid, it may be unwise to attempt to open the jar, as it may explode in your hand.

Similarly, leaking roofs lead over time to the buildup of moisture, which promotes mold growth. Deteriorating structures can release degraded components of adhesives, coatings, and other materials. At first, the presence of a leak is an unsightly annoyance. Over time, it becomes a potential cause of asthma.

Schools need expertise, resources, and a policy of prevention to address EHS concerns effectively

Most staff contacting OTA did not have special duties pertaining to environmental, health and safety issues. Schools need help in the area of expertise - to recognize problems before they arise or become acute, and to address those that are currently impacting on the health and safety of students, staff, and the community.

Many solutions require investments of time and/or money. These range in cost from low (replacing ventilation filters, purchasing explosion-proof chemical storage cabinets) to high (installing full, functional ventilation systems and new roofs). To do everything on a short timetable would be costly. But there are many practices that schools could follow to reduce the costs of being in compliance. Chemical use reduction is a sensible place to start.

III. Findings And Recommendations Provided To The Schools

The number of requests for site visits was far greater than anticipated, an indication that this project's subject matter addresses a need. Requests for OTA's onsite assistance were an immediate result from only a few speaking engagements and meetings. Word of mouth then began to generate further requests. After workshops on how to use the *Tools for Schools* manual, further requests were generated. The fact that fairly minimal outreach was all that was needed to generate a strong response is an indication both that the need is great, and that the offer of assistance is welcomed. (After the completion of the CURIAS project, OTA received further funding from EPA to continue site visits. Project Officer Lisa Dufresne has now visited over 60 schools).

Each of the 34 schools visited received an onsite consultation and a follow-up report highlighting pollution prevention strategies and indoor air quality improvement recommendations. Other deliverables included:

- a photocopy of the EPA manual *Tools for Schools* (unless it was not yet available or the school already had it);
- technical information that would help them implement a pollution prevention and indoor air quality improvement plan (a list of available documents is in Appendix 5); and
- a copy of the American Lung Association video on indoor air quality issues in schools (15 minutes)

The technical reports provided background information on indoor air quality issues and a written documentation of the specific issues found at each of the schools visited. The reports made specific recommendations on corrective action that could be taken to improve the indoor air quality at that specific site. Information on toxics use reduction techniques was provided for those areas of the school where hazardous materials are used and stored.

The following sections detail first the air quality problems and then the chemical use reduction opportunities found during the visits.

Note: The information in the charts on pages 6 - 8 does not refer to all schools visited by OTA. Please note that the number of schools at which each issue was examined is specified for each item.

A. Indoor Air Quality at Visited Schools

Air quality measurements

The reports began with an overview of ventilation which describes how a typical ventilation system works. The reports explained that carbon dioxide measurements were taken to assess whether fresh air was being provided to the school classrooms and offices (CO_2 is not considered a hazard by public health officials at the levels measured in this report. It is used as an indicator, or surrogate measurement of the adequacy of a ventilation system).[1]

Just measuring CO_2 does not tell you enough about the adequacy of ventilation. Each report where carbon dioxide measurements were taken also included a chart displaying information on where the measurement was taken, the number of occupants in the area, the time of day, the carbon dioxide levels, and notes (such as whether windows were open, mold was visible, univents were blocked, excessive dust visible, exhaust grills blocked, etc.).

OTA was able to borrow equipment for CO_2 measurements to be taken at 11 schools. The chart below shows that at one school, almost all (90%) of the classrooms measured exceeded action levels. It also shows that <u>all</u> of the 11 schools had some classes exceeding 1000 ppm of CO_2. Only two schools had as low as 10% of classes with levels under 1000.

SCHOOL	# CLASSROOMS MONITORED	% EXCEEDING 1000 PPM CO_2
1	10	90%
2	31	81%
3	23	48%
4	12	42%
5	22	36%
6	32	31%
7	16	31%
8	44	18%
9	36	17%
10	31	10%
11	33	10%

[1] When we performed the assessments, we calibrated the monitor to outdoor levels and then took 700 ppm above that as our action level. This practice, which is standard, assumes that outdoor levels are about 300 ppm and the action level should be 1000 ppm. It must be noted that outdoor levels have frequently been found to be higher than 300, ranging up to 600 ppm, and that some agencies believe action levels should be lower than 1000 ppm.

The following charts summarize those indoor air quality issues found in the schools visited. The chart lists the percentages of those surveyed on the issue answering yes or no, and the number of schools with each issue. *All of the issues were not checked at each school, so the number in parentheses does not equal the total number of schools visited - just the number surveyed for that issue*.

ISSUE	% YES	% NO	NOTES
# SCHOOLS WITH CO_2>1000	100% (11/11)		
In. Air Qual. Team	12% (3)	88% (22)	2 towns, 3 schools
univent turned off	54% (7)	46% (6)	
blocked univent	55% (6)	45% (5)	
no air source	58% (7)	42% (5)	
univent barely on	56% (5)	44% (4)	
dirty exhaust	90% (9)	10% (1)	
no exhaust	73% (8)	27% (3)	
broken exhaust	89% (8)	11% (1)	
blocked exhaust	50% (5)	50% (5)	
sealed windows	33% (4)	67% (8)	
unvented copiers	88% (15)	12% (2)	
unvented dupl. machines	40% (2)	60% (3)	
unvented custodial storage area	70% (7)	30% (3)	
unvented science lab	100% (18)		
unvented science chem storage area	88% (15)	12% (2)	
broken fume hood	83% (5)	17% (1)	
uncalibrated fume hood	100% (6)		
unvented ceramic kilns		100% (5)	
ventilation source	UNIVENT - 8	ROOFTOP-4	BOTH - 4
filter change freq.	Never - 3	1/yr - 5	2/yr - 5 4/yr - 5

ISSUE	% YES	% NO	NOTES
calibrate univent	10% (1)	90% (9)	
flat roof	69% (9)	31% (4)	
leaky roof	39% (7)	61% (11)	
visible mold	38% (6)	62% (10)	
basement classrooms	43% (6)	57% (8)	
add humidity		100% (16)	
stained ceiling tiles	82% (14)	18% (3)	
visible dust	80% (8)	20% (2)	
carpeting	80% (12)	20% (3)	
clean univent	11% (1)	89% (8)	
thermal warming issues	15% (2)	85% (11)	from solar sources
energy mgmt system w/ CO_2 monitoring	10% (2)	90% (18)	
pesticide use outdoors	11% (1)	89% (8)	
pesticide use indoors	60% (6)	40% (4)	
inadequate custodial maint. Staff	83% (5)	17% (1)	
ever cleaned ducts	12% (2)	88% (14)	supply or exhaust
Hired IAQ Consult.	32% (7)	68% (15)	2 were state audits
P2 options available	91% (21)	9% (2)	
referral from:	workshop - 11	word of mouth - 2	looked for help - 1
	complaint - 1	article in paper - 1	
unvented photography dept	100% (3)		few schools have this facility

The reasons for the high levels of CO_2 vary. Some of the readings were due to inadequate or broken ventilation systems. Other readings were due to overcrowding in the classrooms.[2] Still others were due to "open concept" classrooms being closed up (walls added where none had been previously) and the ventilation systems were not adjusted.

Proper maintenance of air handling units

Only one in ten schools ever calibrated their univent heaters and only one school had ever balanced its air handling units.[3] Only one of the surveyed schools had ever cleaned its univent heaters (*Tools for Schools* recommends vacuuming univents whenever filters are changed, ideally four times per year). Only two of 16 schools had ever cleaned their ductwork, supply or exhaust (none knew if the ducts had ever been checked for dirt buildup). Only two of the 20 schools surveyed had installed energy management systems which automatically monitor carbon dioxide levels and adjust the ventilation system to keep CO_2 levels below 1000 ppm.

Indoor Air and Temperature Control

Two schools had thermal warming issues (solar warming). However, most of the schools had problems maintaining temperatures that would be comfortable for all staff, especially in winter. These schools had to grapple with both thermal issues and indoor air quality, as the staff would consistently consider these two separate issues to be one big problem. The ability to identify these as two separate issues helped some schools deal with teacher dissatisfaction about their

[2] Ventilation systems are designed to supply fresh air to a maximum number of occupants per classroom. Many classroom fresh air supplies are based on 25 occupants. When class size exceeds the capacity of the ventilation system, carbon dioxide levels may rise above 1000 ppm.

[3] Air balancing is done to ensure that classrooms are receiving the proper amount of fresh air and that exhaust systems are working adequately to remove stagnant air and provide air flow through a room. It's done by measuring air flow to all rooms and adjusting dampers (or repairing the system) accordingly.

indoor environment.[4]

[4]Teachers consistently believed that warm dry air was associated with "bad" air, or high levels of CO_2. Since many schools have heating systems that are independent of ventilation systems, this may not be necessarily true.

Two-thirds of the surveyed schools had windows that open. There was strong sentiment among teachers at these schools that schools with sealed windows automatically had inferior indoor air quality. [5]

Roof leaks and mold

Nearly 70% of the schools had flat roofs, a typical construction method for buildings in the 1970s and 1980s. About 40% of schools had repetitive roof leaks and another 40% of schools had visible mold growing on ceiling tiles, walls, and floors. Eighty-two percent of surveyed schools had stained ceiling tiles and many did not have a maintenance procedure for replacing them. (Wet ceiling tiles are potential sites for mold growth). Almost half of the schools had basement classrooms, further adding to the potential for mold and mildew in the classes. Luckily, none of the schools added humidity to classrooms during the dry winter months, as this could promote mold growth.

Venting copiers

Most of the schools surveyed did not vent photocopiers. Two of the five schools still using duplicating machines did not provide ventilation for these units. At one of these schools facility staff showed OTA an article stating that unvented duplicating machines can exceed the OSHA eight hour limit for methanol in less than 15 minutes, yet ventilation was not provided. Most schools were unaware of the health threat associated with exposure to methanol from these machines.

Venting chemical use areas and using Material Safety Data Sheets

Seventy percent of the schools surveyed did not vent custodial storage areas, despite the fact that many chemicals of a toxic and flammable nature are stored there. There was a general misunderstanding about the hazards associated with these materials. Most schools simply did not consider these chemicals to be dangerous because they are “just used for cleaning”. Few of the schools had really examined the material safety data sheets for the chemicals used in this department. However, there were several elementary schools that had eliminated nearly all hazardous chemicals from their custodial areas and were using bulk cleaning systems which

[5] This may be more an issue of controlling the environment that an actual IAQ problem. Teachers whose windows opened felt more in control of their environment.

greatly reduce chemical handling and toxicity.

Having a program to address indoor air quality

Only three of the 34 schools had formed an indoor air quality committee. Two of these schools were in the same town (one that had significant air quality problems). Most of the other schools had only just received their *Tools for Schools* guide from EPA. Some expressed concern over starting such a committee and whether it would be akin to opening a can of worms. Many had no plans for implementing an IAQ committee, despite their problems.

Paying attention to carpeting

Eighty percent of the schools had some carpeting. Since most schools didn't have adequate custodial staff to maintain the facilities, these carpets were not being properly cleaned. Most were vacuumed daily or weekly, and steam extracted (cleaned) once or twice a year. This is an inadequate schedule to remove dirt and dust brought in daily by several hundred students plus the staff. Several schools had carpeting that was original to the structure and more than 20 years old. It's likely these carpets were a source of dust, mold and other allergenic material which may have caused some of the symptoms of the students and staff associated with these buildings. In several schools, these carpets lay on the slab foundation of the building with no padding or foundation insulation. When we looked under the carpets, there was a thick layer of dirt and dust which was not being removed by the schools' cleaning procedures. Eighty percent of surveyed schools had visible dust present. Clearly these numbers indicate that a lack of sufficient custodial activity is leaving a large amount of allergenic material in school buildings.

Minimizing pesticide and herbicide use

Only one school sprayed lawncare chemicals outdoors, and this was for purely aesthetic reasons (they wanted the field to look nice). Sixty percent of surveyed schools sprayed indoors, but most were on an "as needed" basis and mostly limited to the cafeteria. (We did not ask if a licensed applicator was used, as required by law). All of the schools were interested in Integrated Pest Management (IPM) strategies and most thought they would implement such strategies in the future.

Special problems of science classes

The indoor air quality in the science classes fared poorly. <u>All</u> of the science classes that had laboratories in them were not vented adequately. Many had CO_2 levels below 1000 ppm but none of them could accommodate the additional fumes associated with the laboratory experiments. Nearly 90% of these schools had unvented chemical storage areas. Many of these had an overpowering odor from leaking bottles of various ages and conditions (mostly old). Nearly 85% of fume hoods located in science department were broken or not functioning, and *none* of the fume hoods had been calibrated or regularly maintained.

Art rooms

Art departments fared much better. Many had an additional ventilation source, and all of the ceramic kilns encountered were vented directly outdoors.[6] Most art departments had switched to all water based materials, with only a few still using oil based paints and varnishes. However, there was no additional ventilation supplied in the photography labs within the art area. There were only three schools that had the capability of developing photos, and none of them vented the developing room adequately (one had no ventilation at all).

B. Chemical Use Reduction Opportunities

Summary

Of the schools surveyed for pollution prevention opportunities, (not all of the 34) more than 90% (21) of the schools surveyed had significant opportunities. Although some schools had made strides to reduce chemical use, no school had instituted a facility-wide program of pollution prevention.

General - Material flow controls

Generally, schools should institute purchasing systems and policies to restrict the inflow of materials that present hazards, and should consider material flow controls. Such controls, which can cover the range of materials use activities from ordering to final disposition, can prompt the investigation and use of safer alternatives, and can prevent overpurchasing. They can provide assurances that materials are properly used and safety precautions taken. Any material that presents a disposal problem should be flagged when purchase is requested. At that point, the request can be examined and if alternatives cannot be used, methods for reducing the amount purchased can be explored.

Material flow programs should include all operations that take place on school grounds, including contractor work and nighttime adult education classes. At a minimum, purchasing controls raise

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[6] The State Building Code, as well as local fire code, requires the venting of hazardous exhaust and the products of combustion. The Department of Public Health recommends outdoor venting due to the potential production of carbon monoxide, sulfur dioxide and lead fumes from the pottery firing process.

awareness, which in many cases results in reduced amounts of hazardous chemicals on site. More advanced control systems track and quantify materials use, identify where losses occur, and provide an understanding of how unnecessary costs (from waste) may be eliminated.

A prominent example of a problem resulting from the lack of appropriate controls is the acceptance of free samples. Schools are often given free samples of a variety of products, sometimes by vendors, and sometimes just as gifts. School personnel need to look closely at these gifts to be sure they aren't toxic and indeed can be used, and will be used within a reasonable amount of time. It makes sense to establish a policy of not accepting gifts of chemicals or chemical-containing products until it is clear that the item will not simply become a disposal problem. A procedure for making such determinations should be created.

Another example is the "bargain" that buying larger quantities seems to represent. Although the per ounce cost of the chemical may be lower when larger amounts are purchased, the ultimate cost may be much higher if the chemical is expensive to get rid of, and much of it is left over.

Science departments

Science departments had many areas where pollution prevention could be implemented. Unsafe experimental procedures, such as those using explosives or highly flammable materials, should be eliminated and substituted with new teaching methods using environmentally preferable materials. Particularly dangerous chemicals, if deemed important enough to retain in the classroom, could be used in demonstration procedures - that is, the teacher will conduct the experiment, and the material will not be handled by each student. Safety procedures can be more strictly observed, and made a more central part of the teaching mission.

Few schools were using microscale chemistry, which offers exceptional opportunities for reducing chemical use and storage. Microscale chemistry is a way of carrying out chemical processes using sharply reduced amounts of chemicals. New techniques, methods, and equipment are sometimes necessary which may be why microscale labs aren't seen more often at the high school level. However, the reduction of high volume solvent use results in a clear improvement in indoor air quality, as well as reduced exposure (up to a factor of 2000) to potentially toxic chemicals.[7]

Traditional chemical uses of 10-50 gram (solids) or 100-500 milliliter (liquids) level can be reduced to 25-100 milligram (solid) or 100-2000 nanoliter (liquids) - very large reductions in quantity are possible. This is partly because you only need to use as much as is necessary to observe the result, and because detection techniques have improved. But it is also because traditional amounts have been taken for granted, and reducing quantities was never an issue before. Even without switching fully to microscale, chemistry procedures can be reformed.

[7] Data supplied by Merrimack College's National Microscale Chemistry Center

In high school chemistry programs, implementation of microscale chemistry can be implemented without having to spend excessive funds on glassware. This is unlike college programs where the laboratory experiments performed require specialized glassware to meet curriculum standards. A major advantage of microscale chemistry is the reduced time it takes to complete an experiment. Less chemical is used, resulting in faster reaction times, less air pollution, and a healthier and safer environment. Considering how many classrooms had inadequate ventilation, this should be an important factor in propelling schools towards this practice.

Microscale chemistry also sharply reduces the chemical inventory required. Many of the IAQ problems in science departments are caused by vapors leaking from chemical containers in poor condition. OTA's experience with schools has been that more than half the chemicals stored in science departments will never be used, either because they are in poor condition or because too much was purchased. These chemicals usually end up as hazardous waste which must be disposed of at great expense to the school. Implementing microscale chemistry allows the school to keep a much smaller inventory, therefore less is wasted, and reduced emissions are generated in stockrooms (which are typically not vented). Microscale chemistry teaching materials are now widely available for high schools.

Another tool for science departments to use is a working inventory system, which can be computerized (but doesn't have to be). Most schools that OTA visited do not have updated inventory systems, usually resulting in redundant purchases of the same chemical. Many schools have two to five containers of the same chemical, often in different places, because they had no inventory of their stock. While time consuming, inventorying is not expensive and can be a very cost effective way to reduce overstock and waste.

A good inventory system can also help schools during curriculum changes. Knowing what is in stock may prevent schools from switching to new lab experiments and ending up with chemicals that are no longer necessary and may never be used. Even if the chemicals may be used some time later, it is clear from the audits that once chemicals sit unused for a few years, many teachers are reluctant to use them, especially if they did not purchase the chemicals themselves. Teachers may accept unopened chemicals if they are properly labeled and their date of purchase has been recorded.

Biology labs are another area where pollution prevention can be implemented. While most biology classes are not using specimens preserved in formaldehyde, some still are. Specimens are readily available that are not preserved in formaldehyde, a human carcinogen, and don't require disposal of the formaldehyde solution. Specimens are also available freeze dried. While these don't last as long as preserved specimens, they may be appropriate for some lab work.

Art departments

There was a distinct difference in the amount of hazardous materials used in elementary school art programs, compared with those in middle and high schools. There were far fewer instances of hazardous material use in the lower grades, with most if not all schools using certified nontoxic art products. High school art programs had the highest incidence of hazardous materials use.

While most schools used nontoxic paints and glazes, there were some that used solvent based materials. These were primarily high schools with advanced art courses. According to the staff at these schools, painting classes require the use of oil paints. However, reduced waste can still be accomplished through proper storage and use of the paint, and cleaning of the brushes.

Reusing the solvents to clean brushes is an important toxics use reduction technique which was not being practiced in some schools. Some schools had old solvents in storage that were rarely used. These were noted and the school encouraged to dispose of them. At least one school used rubber cement in an area with insufficient ventilation. This school was encouraged to use alternative gluing methods, or at least move this operation to an area with sufficient ventilation. Some schools had less toxic alternatives readily available, but were not using them.

Schools with ceramic programs have their own unique problems. While most schools buy ceramic glazes, there were a few that mixed their own. While this results in a wider variety of glaze for students to choose from, it introduces hazards that may not be present in the purchased glazes. One school in particular had problems with the art teacher mixing glazes with potentially hazardous ingredients. This teacher was given information on how to determine the toxicity of the glaze ingredients so that he could reduce the toxicity of his mixes without sacrificing variety. Another problem in some ceramic programs is that the use of powdered clay can result in a significant amount of dust which is rarely vented properly. These schools were encouraged to purchase their clay premixed (wet) so that some of the dust exposure could be avoided.

Finally, some schools have photography programs, including dark room development of film. Rarely is the silver discharge from these operations managed properly (usually it is flushed down the drain with no permits or permission from local POTWs). These schools were instructed on the best ways to recover the silver (if they had a large enough quantity), or the best way to collect it and send it for recovery. Schools discharging to POTWs were encouraged to contact their treatment works director to find out what regulations applied to them. All the schools with photography operations indicated they would change their practices and stop discharging silver waste down the drain.

Custodial/maintenance departments

Hazardous materials are often used in the custodial/maintenance departments, and include cleaning products, disinfectants, floor waxes, pesticides, laundry detergent, paint, oils, and solvents. There are usually many opportunities for toxics use reduction.

Many schools are adopting a system of cleaning that requires the purchase of fewer types of products. This system uses three or four basic components which are mixed in various proportions to make a wide variety of cleaners for different applications. Rather than having a dozen different chemicals on the shelf, the school has a "cleaning center" with three or four chemicals in bulk with a dispensing system. This significantly reduces storage requirements, and fumes are reduced as most of these mixes are water based. Since ventilation of custodial and maintenance areas is often poor, reducing vapors is a significant way to improve risks to staff health.

Schools are encouraged to reduce their cleaning needs by assessing how some dirt enters the building. Using rugs and rubber mats at entrances can capture much of the dirt that would otherwise require cleaning chemicals to remove. However, wholesale use of carpets throughout the school is <u>not</u> recommended.

Latex paint can be used for most applications at schools. This reduces the use of solvent based paints, and the associated solvents used to clean brushes and pans afterwards. Solvent based paints are used in many schools, and usually use can be substituted with latex paint. However, schools report that solvent based paints are almost always used on door jams and in hallways. This is because cleaning dirty walls with oil based paint can be done easily; however repainting must be done if latex paint is used. Their belief is that using solvent based paint less often, supplemented with cleaning, uses less toxic material than constant repainting with latex paint. Some schools use the same few colors throughout the school, and wrap the paint brushes in plastic in between use to eliminate cleaning.

Schools should also look at maintenance issues such as retiling floors and urethaning wood floors in gyms and other areas. Water based sealants are manufactured for gymnasium floors which significantly reduce air pollutants when applied. Water based floor tile adhesive is also available and schools are encouraged to use it whenever retiling is required. Many air quality complaints have been associated with these types of maintenance activities, since solvent based products have traditionally been used.

Pesticide use is another activity which, while not entirely within the control of the maintenance/ facility department, will be addressed here. Pesticides are used to control pests both indoors and outdoors at schools. Outdoor use is primarily aesthetic (weed control for fields and paved lots) though some termite and ant spraying has been reported. Indoors, spraying is usually limited to the cafeteria, where pests are introduced in food delivery containers. Few schools regularly sprayed for pests. Most opted to spray only when pests had been spotted (this included cafeterias and culinary arts kitchens at vocational schools). However, integrated pest management strategies can be used at any school.

Integrated Pest Management (IPM) is a common sense approach to pest management that uses a variety of methods to control pests. Chemical pesticides may be part of an IPM program. However, considerable effort is also put towards preventing pest problems by controlling conditions in buildings which may attract and support pests. IPM focuses mainly on eliminating or reducing sources of food, water, and harborage that are available to pests, and limiting pest access into and throughout buildings. Control measures such as sanitation, building maintenance and modifications are strong elements of a structural IPM program. Successful programs include a pest control supervisor, and training for all building occupants. IPM also includes working closely with a pest control contractor to keep records of pest activity, report on progress, and regular monitoring. Few schools actually have a full integrated pest management program, and all were given information on how to develop one.

School custodial and maintenance staff need to understand and use material safety data sheets (MSDS). Since new products are continually being developed for activities in these departments, custodial and maintenance supervisors will often be in a position to switch products. If they understand how to use MSDSs properly, they can continue to use the least toxic product available for the job.

Administrative offices

Some schools are still using duplicating machines, which use a fluid that contains a high percentage of toxic solvents. Rarely are these machines vented properly, and staff using them could exceed OSHA's allowable exposure level in under 15 minutes of continuous use [8]. Schools were strongly encouraged to properly vent and limit their use of these machines, and ideally, to eliminate them altogether.

Vocational shops

Vocational shops provide a wide array of opportunities for toxics use reduction. Many shops had already implemented TUR techniques, especially if the TUR techniques were a regulatory

[8] Data supplied by a U.S. Department of Labor report to a school in Massachusetts that used a duplicating machine.

requirement (such as HVLP [high volume, low pressure] spray guns in autobody shops). Since the goal of vocational shops is to teach the skills required in the workplace, it is often not feasible to switch chemicals to something less toxic if it is not an industry standard. Toxics use reduction opportunities for specific shops are highlighted below.

Autobody

Polyurethane paints, lacquer thinner, and other solvents are the main toxic materials used in these shops. Others include polyester resins, fillers, coloring agents, and polyamide resins. While there were some opportunities for material substitution, the bulk of the opportunities centered on material management.

Most of the vocational shops visited during this grant had automatic coloring systems that dispense paint in the proper color without hand pouring and mixing. These systems reduce the amount of paint wasted because the wrong color is mixed less often, and there is not usually any spilling of paint. In addition, there is little or no cleaning involved in these systems, since colors all have a dedicated line. However, schools without these systems would be more likely to experience wasted materials due to mistakes in color mixing, or students' inexperience.

In accordance with regulatory requirements, most if not all schools should be using HVLP (high volume, low pressure) spray guns and have spray booths in which to paint vehicles. All of the schools visited during this grant had both of these. Using the HVLP guns reduces wasted material resulting from overspray and rebound.

Auto repair

Most of the auto repair shops found in vocational schools do a variety of pollution prevention activities, such as recycling oil, antifreeze, batteries, and parts cleaners. However, there is an opportunity to use a less toxic parts cleaning system. Many schools use a service for their parts cleaner, which uses a high VOC solvent, and have not investigated less toxic solvents.

Some TUR techniques that could be used at some of the schools include draining oil filters for at least 24 hours to remove all oil, recycling oil filters rather than disposing of them, implementing procedures that might minimize spills of oil and gasoline, and switching to reusable rags rather than paper towels.

Carpentry

Wood shops typically use a variety of paints and stains to finish pieces made throughout the year. These shops could reduce their toxics use by using only water based paints, stains, and urethanes. This would eliminate toxics used on the pieces, and eliminate toxics used for cleaning. (Some materials, such as Kilz and Bin, may only be available in solvent based form). Also, pouring a small amount of paint, stain, or urethane into a container for immediate use could reduce the amount of drying that occurs in large 1-gallon containers, and perhaps prolong the life of some of the materials used in this department.

Cosmetology

TUR techniques include using pump hair spray rather than aerosol sprays, avoiding formaldehyde-containing shampoos, seeking out and using less hazardous product lines[9]. Products to avoid include those containing phenol, petroleum distillates, and quaternary ammonium compounds (dyes, barbicide, perms, etc.). Minimizing the use of artificial nails and favoring press-on nails will reduce exposure to some toxic materials. Using non-permanent dyes, such as henna, chamomile, or saffron, over permanent dyes, reduces toxics use. Using bleaches without persulfate boosters is another TUR opportunity.

Culinary arts

These areas use a variety of cleaning products, often independent of custodial cleaning supplies. Therefore, culinary arts staff should be trained in reading MSDSs so that they can compare these products and choose the least toxic for the job. The biggest opportunity in this department is implementing IPM techniques. Every kitchen visited had sprayed for pests at some time. Integrated pest management strategies would help the staff to identify how pests were entering the area and give them less toxic methods to reduce or eliminate pest infestations.

Printing

Print shops offer a number of opportunities for toxics use reduction. These include scheduling press runs according to colors to reduce the number of times that press machines need cleaning. Limiting darkroom use by carefully scheduling work on negatives can reduce chemical use. Few schools are using soy based inks since they believe that switching will cost money. However, making this switch reduces toxics use and improves air quality a great deal. Schools that have made the switch have not indicated that it cost a lot of money.

Miscellaneous

Other vocational shops, such as plumbing, electrical, metalworking, etc. can all benefit from TUR by taking a look at chemicals used in the area and reading their MSDSs. Most vocational shops visited had at least one opportunity for TUR once we took a detailed look at inventory and

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[9] See pages 20-27 of "Toxics Use Reduction Plan", Smith Vocational and Agricultural High School, Northampton, MA, for more specific recommendations for alternative hair products. Copies available through MA OTA, the Northampton, MA Board of Health, and Smith Vocational and Agricultural High School.

MSDSs. Schools need to teach their staffs how to read MSDSs so they can begin to look at their own chemical use and understand why a product is considered hazardous.

Perhaps most importantly, however, students would benefit greatly from training in understanding the hazards of the chemicals used in all of these areas. When they enter the workforce they may either be exposed to the chemicals or have professional responsibilities relating to them. They may be in positions to reduce harm to themselves or others. Involving them in understanding hazards and risk reduction and pollution prevention techniques should be an important part of their education.

IV. Results

The objectives of the CURIAS project were:

1. To establish contacts with those sources of information that could be enlisted to participate in creating written materials for distribution to MA schools.

2. To hold one or more conferences for school officials to present the information gathered from those sources and distribute the EPA manual *Tools for Schools*, targeting administrators, department heads, teachers, facility managers, and business managers.

3. To deliver onsite assistance to at least twenty (20) schools across the state to help them identify chemical use reduction opportunities and teach them how these chemical sources can be detrimental to indoor air quality.

4. To create an electronic network to serve as a continuous source of information for users that can connect to the Internet, and link this service to Merrimack College's Microscale Center.

5. To develop an information package available at no charge to workshop attendees and any other school official or parent that requests it.

The results show substantial achievement of the project's objectives. OTA is currently pursuing related projects to continue and extend the work performed under the CURIAS grant.

1. Contacts were established with many other indoor air quality service providers, including:

- MA Department of Public Health
- MA Department of Labor and Workforce Development,
- Division of Occupational Safety
- City of Boston, Department of Health and Hospitals
- Boston Society of Architects, Indoor Air Quality Committee
- MA Department of Food and Agriculture, Pesticide Bureau
- University of Massachusetts, Amherst, Department of Entomology
- Merrimack College Department of Chemistry
- Maryland Department of Education
- Harvard School of Public Health

- The Environmentally Accessible Buildings Project.
- American Lung Association
- Asthma and Allergy Foundation

2. Two well-attended, well-received conferences were held.

Due to the overwhelming response to the first scheduled conference held January 16, 1996, a second conference was immediately scheduled and held on March 11, 1996. One hundred and seventeen people registered for the first workshop and 55 people registered for the second; a total of 172. They were asked to fill out evaluations using a scale of 1-5, five being the top score. The average scores of the individual evaluations for these workshops were:

1-16-96 4.46 for content and 4.41 for presentation
3-11-96 4.55 for content and 4.45 for presentation

Each conference attendee received a copy of the EPA manual *Tools for Schools* and a package of other useful information. The first conference was videotaped and free copies are available by contacting OTA. A survey has been sent to all workshop registrants to evaluate the usefulness of the *Tools for Schools* manual. An analysis of the results of this survey has been performed and is attached.

In addition, Project Officer Lisa Dufresne made a number of presentations on the link between pollution prevention and indoor air quality. Many of these presentations resulted in requests for onsite assistance.

DATE	SPONSOR	PLACE	PARTICIPANTS
1/23/95	Randolph HS Science Dept.	Randolph HS	10
3/10/95	Cape and Islands Business Mgrs.	Sandwich MS	6
3/14/95	Taunton River Watershed Assoc.	Bridgewater State College	25
3/21/95	Principal of Boston Area School	Boston area	15
4/1/95	Northern Essex Com. College	NECC	32
4/3/95	Northbridge HS Science Dept.	Northbridge HS	8
5/19/95	Middleboro HS Science Dept.	Middleboro HS	6
11/21/95	MA Executive Office of Environmental Affairs	Middlesex Com. College	55
12/7/95	MA Assoc. Business Officers	Milford	110
4/24/96	MA Fire Prevention Officials	U-Mass Amherst	75
5/7/96	New England Environmental Expo	Boston	10
		TOTAL	**336**

(Future requests for technical assistance with indoor air quality issues will be referred to the other two agencies that perform onsite consultations: The MA Department of Labor and Industries (Division of Industrial Hygiene), and the MA Department of Public Health. Referrals will also be made to the US EPA where appropriate).

3. Thirty-four schools were visited and provided with technical consultation, as detailed in the body of this report.

4. An electronic network was created to serve as a continuous source of information for users that can connect to the Internet, and link this service to Merrimack College's Microscale Center.

The creation of an electronic network has been completed and will be updated periodically. Information is currently available on the MA OTA web page (www.magnet.state.ma.us/ota) by clicking on the name Lisa Dufresne and e-mailing that individual for more information. There are several links that can be made from this web page, including Merrimack College's National Microscale Center (http://silvertech.com/microscale), EPA's Indoor Air Quality site (http:/epa.gov/iaq/schools.html), and several other sites that offer specific information on IAQ or TUR issues. Attached to this report is a list of useful web sites, including many that can be used to look up material safety data sheets in order to compare chemical hazards.

5. An information package was created which OTA makes available at no charge to workshop attendees and any other school official or parent who requests it.

Because of the overwhelming amount of information available to schools on the issue of chemical use reduction and indoor air quality (nearly 70 documents), OTA decided to create an information order sheet rather than a standard information package. This way, schools can tailor their orders to the information that they need. This order sheet is available online at the OTA web site. It is also available to all workshop participants and any other interested party. A copy is provided in Appendix 5.

V. Conclusions

We found that inadequate attention was being paid to environmental, health and safety issues in the schools we visited. Not enough fresh air was being delivered to the classrooms, and few controls existed on the potential sources of chemical exposure. The report shows that there are many ways to reduce the risk of real or potential harm to students and employees that do not involve costly or complicated procedures. However, these methods cannot be employed unless people are aware of them. Therefore, what schools need is a greater knowledge of the problems that do exist, and the many opportunities available for reducing risk.

When this project was started, we assumed that schools might not be able to afford to turn their attention to this area. We expected that focusing on environmental, indoor air quality, chemical use and waste issues might result in demands for expensive projects that few schools could afford. However, as the project results make clear, although there are some problems, such as leaky roofs, that require capital investments, there are also many problems that can be addressed by inexpensive means - most notably common sense, and the time-honored technique of shopping around for product alternatives.

In the course of our work, we found that a number of agencies and organizations do provide relevant services to schools, but few schools know how to tap these existing resources. In 1998, OTA participated in the formation of the Massachusetts Multi-Agency Task Force on Environmental, Health and Safety Issues in Schools (MATS), a group of representatives from various public and private organizations. MATS is dedicated to elevating awareness of environmental, health and safety issues in schools, and creating and coordinating resources for solutions. MATS is an unofficial body, with no grant of authority or funding. It exists solely because of the concern of professionals with knowledge of the problems in schools, and the potential for significant improvements in the current situation.

MATS discussions have focused on the need and opportunities for incorporating environmental, health and safety issues into the management structures of our schools and school systems. This is important so that compliance with all EHS requirements will be ongoing, and so that full realization of pollution prevention and resource conservation opportunities will be possible. These opportunities exist with regard to facility design, renovation, and management, and in materials purchasing and all aspects of handling. Training of staff and measurements to assess progress are important features of an environmental management system. Finally, there is a tremendous teaching opportunity in the integration of environmental management activities into student educational programs.

Many of the solutions to EHS deficiencies that we found in visited schools should not cost a lot of money. Some renovations may be necessary, but many issues can be resolved by changing practices and materials use.

But even if expenditures are involved, the longer view shows they will be a good investment. As EPA's *Tools for Schools* manual observes, "schools that can demonstrate ongoing efforts to provide a safe indoor environment are in a strong legal and ethical position if problems do arise." The manual suggests considering the benefits of a proactive approach:

* Quicker and more cost-effective response if problems occur
* Greater peace of mind for parents, students, and staff
* Physical plant and equipment provide better comfort and efficiency, and last longer
* Less crisis intervention which involves upper-level management

Most importantly, safer schools will mean safer children.

Appendices

Appendix 1

Descriptions of Technical Assistance Visits

By OTA Project Officer Lisa Dufresne

School "A"

School A is an example of a school constructed in the 1970s. It has a flat roof (which leaked chronically), and the inside was designed as an open concept facility. While many such schools subsequently built internal walls, this school did not, and continued to function in its open capacity. The school was fully carpeted, with the carpet dating back to its opening in 1975. The air supply system in this school is through univent heaters.

Of the thirty four schools that were visited during the grant, School A had the highest percentage of surveyed classrooms having CO2 levels above 1000 ppm (24/29 or 83%). This school had been experiencing indoor air quality problems for several years and in 1995 had hired a consultant whose report similarly indicated ventilation problems. However, it was unclear whether any of the recommendations of the consultant had been implemented.

Several of the univents in the survey areas had been shut off. This is typical practice in many schools. Teachers find univent heaters noisy while they are blowing, and often turn them off. Staff at most schools had no idea how fresh air is brought into the facility and therefore did not understand that shutting of the univent meant eliminating a fresh air source. This problem is so severe in some schools that the manual on/off switch had to be removed from univents to keep the staff from tampering with them.

Another factor affecting the flow of air in this school was the ceiling tiles. A great number of ceiling tiles were missing in this facility, with the greatest number on the third floor (directly under the roof). The tiles were missing because they were so severely damaged from leaking water that they fell in. Therefore the pressure system that was designed into the fresh air supply system was completely nonfunctional. The return ducts could not compete with the holes in the ceiling for capturing the air in the room. The fresh air entering the room could bypass the room entirely and end up in the area above the ceiling tiles. The whole system was nonfunctional. Noone I spoke with at the facility understood the effects of the missing ceiling tiles on the flow of air in the school. Perhaps if they had, there would have been less delay in replacing the tiles and repairing the leaking roof.

School A also suffered from the most extensive case of mold growth I've seen in any school. The mold in the walls extended from the roof to the foundation, on all three floors. Sheetrock peeled off walls on the top floor and was severely damaged on the bottom two floors. Visible mold could be seen on all floors, on walls, and on ceiling tiles. Although it could not be seen on the carpeting, it is likely it flourished there as well. I was told this condition had existed for many years.

The carpet at School A was 21 years old at the time of the visit. It was clearly worn. It had not been cleaned in over two years, yet students were sitting on it in many classrooms. Typically carpeting in schools is rarely maintained in such a way as to keep it truly clean. Most schools vacuum carpeting once a day, and only some schools clean it (usually once a year, if done at all). Cleaning usually consists of hiring a contractor to extract dirt with a water cleaning system. Very few schools steam clean the carpet. Lifting the carpeting usually reveals a thick layer of dirt and dust underneath which is a haven for various microbes to live and breed. In School A, this problem is compounded with the addition of water from the roof leak.

School A had several photocopiers which were not vented. Most schools don't vent their photocopy machines, although a few of the schools visited did. School A did not have any duplicating machines, which are still widely used throughout the state, and unfortunately, not always vented.

School A was not evaluated for pesticide use, or for chemicals used by the custodial department.

School "B"

School B also had a history of indoor air quality concerns, which were elevated during a period of construction and renovation in the early to mid 1990's. During this time, the school hired two separate contractors to perform indoor air quality monitoring (March, 1994 and November, 1994). A sample of univent dust was sent to the Department of Labor and Industries, Division of Occupational Hygiene, for asbestos testing in response to inquiries from parents and teachers about excessive dust in the school. In addition, the state Department of Public Health was also called in on two occasions for a survey of the conditions at the school (April, 1993 and June, 1994). Two years later, the school contacted MA OTA (February, 1996) for an onsite consultation.

School B went through several years of construction and renovation which taxed the limit of its occupants' ability to work in a noisy, dusty and chaotic environment. During this time, teachers and parents complained of the severity of the dust and dirt that staff and students were being exposed to during the school day. Early in the process, in December of 1992, a sample of dust from one of the univent heaters (which supplies fresh air to the classrooms) was sent for analysis. The fear was that the construction and renovation process would dislodge asbestos which would enter the classrooms through the univent. The sample, sent to MA Departments of Labor and Industries and the Division of Occupational Hygiene, was tested and no asbestos was found.

In April of 1993, the Department of Public Health was contacted (presumably through the Town's Health Department) to conduct an onsite evaluation of the school. The recommendations resulting from that visit included testing the indoor air for formaldehyde (often found in buildings with new construction) and retesting for carbon dioxide levels during the following winter, when univents are at their most restrictive settings. At that time, some parents indicated their concern for a yellow dust that was being given off by carpet which was newly installed in a section of the new building.

The contractor that installed the univent heaters was then called in by the school to perform carbon dioxide testing in some of the classrooms with new univent heaters. The results were readings that were all well below 1000 ppm. It appears at this time that the system was balanced preceding the contractor's CO_2 monitoring. The results of the monitoring lead the school to believe the system was functioning properly in all of the classrooms.

The school also hired a contractor to survey the indoor air for formaldehyde, hydrocarbons, dust, fungi, and bacteria. This survey was performed in February of the following year (1994). The results indicated that formaldehyde levels were not elevated, volatile organic compound (VOC) levels were not elevated, and fungi and bacteria levels were not elevated. The contractor attempted to characterize the yellow dust coming off the new carpet, but was unsuccessful and further, could find no unusual dirt in the carpet fibers.

In May of 1994, the Department of Public Health returned for a follow-up visit. There were three classrooms where staff were having symptoms they associated with the construction, particularly the yellow dust from the carpet. Carbon dioxide testing was performed, and on this day, several rooms tested over 1000 ppm with temperatures above 75 degrees in most of the classrooms. As a result of the high CO_2 readings, the DPH contacted the contractor that installed the univent heaters to determine the discrepancy between the contractor's CO_2 testing results and those of the DPH. The contractor indicated that the damper linkages for the air supply units were not provided with locking pins, which would result in the linkage disconnecting and the air supply dampers remaining in the closed position. He indicated that he would return to the school and inspect the air supply units to determine whether this situation had caused any malfunction in the units. At that time, the DPH recommended that the contractor perform any maintenance that is required, and the school test again for carbon dioxide.

At this time, it was clear that the newly installed carpeting was faulty and required replacing. The adhesive used to attach the carpet to its backing had failed, and was releasing the yellow dust that was the source of so many complaints. During the summer of 1994, the carpet was removed, the area cleaned, and new carpet installed. However, the dust had been in the area for several years at this point. Since it was sticky, it had been tracked into adjacent classrooms and had gotten into univent heaters within these rooms. In addition, approximately 70% of the total carpet that was installed was a part of the bad batch that resulted in the release of the yellow dust. The manufacturer agreed to only replace the failed carpet, so 30% remained (and was cleaned that same summer). It is this carpet that was in the classrooms where the dust had been tracked and which yielded the staff complaints.

In the fall of 1994, complaints persisted, even after the carpet had been replaced. The school's architect had obtained a material safety data sheet (MSDS) for the backing adhesive to determine whether the product contained any material which may cause health concerns. None were found. However, in response to the concerns raised by the school staff, the architect contracted a firm to do more testing of the adjacent classrooms (which still contained the 30% original carpeting) to determine whether there were any indoor air pollutants. Staff had been complaining for some time of upper respiratory problems and eye irritation which they were feared were a result of the yellow dust.

The results of this round of testing were that respirable dust was not elevated, particulates were not elevated, no moisture or microbial growth was evident, and the yellow dust could not be characterized. This survey did find, however, that the rooms had high levels of cellulose in the dust, presumably resulting from paper products. The levels were three to ten times higher than is normally found in schools. And while high levels of cellulose can result in respiratory irritation, the levels found at the school were not considered high enough for that response. Two of the four rooms tested had elevated CO_2 levels (around 1500 ppm). The conclusion from this firm was that the fresh air units were meeting Massachusetts building codes, but not supplying enough fresh air to keep CO_2 consistently below 1000 ppm. Since they were functioning as designed, the only recourse was to modify them mechanically to supply more air.

In February, 1996, OTA surveyed School B after being contacted by the school administration. At this time, staff in the classrooms adjacent to the area of the failed carpet were still reporting symptoms and harbored concerns that the yellow dust had affected their health. During that time, OTA surveyed 27 areas for carbon dioxide, in both the newly constructed area as well as the old section of the school. The four classrooms of concern were also tested. OTA obtained all relevant testing reports, as well as an MSDS from the carpet supplier for the carpet backing adhesive.

The survey yielded much the same information as had been previously obtained. Carbon dioxide levels were elevated in two of the four classrooms of concern, as well as in nine other classrooms. The MSDS for the carpet adhesive listed no ingredients which themselves were a health threat. No mold or moisture was observed which could have given off VOCs.

One issue that came up during the review of the technical reports from the previous consultants concerned the capacity of the univent heaters, which supply the classrooms with fresh air. These units, which are new in the new section of the building (and include the classrooms of concern) were designed for a maximum supply of 250 cfm outside air. This is enough fresh air for a classroom of 25 to meet the building code of 10 cfm per occupant. However, in order to maintain ASHRAE standards, 250 cfm would only accommodate 17 occupants. The AHSRAE standard is designed for keeping carbon dioxide levels below 1000 ppm, however, the state building code is not. Therefore, it is likely that the classrooms are reaching CO_2 levels above 1000 ppm simply due to their occupancy. The problem is that the air supply units meet building code, yet do not guarantee that CO_2 levels remain at a healthy level. This is likely to be a continuing problem at School B unless the administration decides to spend extra money to upgrade the univents to increase their capacity for outside air.

Finally, the issue of the yellow dust is one that comes up at many schools in different forms. The staff, students, and parents had a concern over a pollutant in the school, which persisted for several years, during which time staff and parents became increasingly angry with and distrustful of the administration. For whatever reason, an effort to keep control of the budget, a lack of understanding of the issue, a school administration may put off dealing with such issues. Taking no action, however, often results in a breakdown of trust, and even if the concerns are eventually met, there is a widespread lack of confidence in the information or solution. In School B, it was yellow dust, in other schools it has been a variety of issues involving air handling units, carpets, mold, and other pollutants.

School “C”

School C is located in a town that decided to deal fully and openly with its indoor air quality problems and which designed a process for identifying issues and sensitive populations within all of the schools. In addition, the town’s Board of Health worked closely with the school’s nursing staff to deal with the health issues and develop their health assessment program.

Problems began in one of the town’s elementary schools in October of 1992 when a parent became concerned that her child was getting ill from one of the classrooms, possibly from an old carpet. The parent insisted that the school check the air quality in the child’s room, and also insisted that she (the parent) choose the consultant. The administration agreed to pay for the testing and let the parent choose the consultant, after which a local lab was contracted to do some IAQ testing. The school did not contact any state agencies, such as the Department of Public Health, at this time.
The contractor used a nonstandard method of checking for air quality. This method involved

taking a sample of air from above the carpet which was taken back to the lab. There, the air sample wasn't tested directly for air pollutants but rather was directed past a series of confined mice. Once the mice had been breathing the air sample for a period of time, they were then released and checked for adverse health affects which were attributed to the pollutants in the air sample. These pollutants were never directly tested for, and therefore remain unknown.

The testing resulted in the death of one of the test mice, presumably from whatever unknown pollutants existed in the sample and the classroom. News of this quickly reached the local papers, and the school system had a crisis on its hands.

At this time, the superintendent of the school district called in state agencies, such as the Department of Public Health, as well as another consultant, to do more extensive and pollutant specific testing. The goal was to specifically identify what the problems were in the school where the initial air sampling had been taken.

Testing results indicated that the school suffered from typical ventilation problems found in schools with poor indoor air quality. Vents had been blocked, fresh air sources had been shut off by teachers and sometimes were not operational at all, ducts had not been cleaned, etc. The testing resulted in the development of a plan for the school district to overhaul the heating and ventilation system for the two schools with these problems.

Electric heat was removed in favor of oil/gas heat. In addition, an energy management system was installed which helped to reduce energy consumption and help pay for the changes. This system included periodic testing (several times a year) of carbon dioxide by the company hired to maintain the HVAC system.

In addition, the school adopted a policy of removing old carpeting and replacing it with a noncarpet flooring. As newer carpet ages and requires replacing, it is removed and replaced with noncarpet flooring. The school hopes to avoid problems associated with dirt, mold, and dust found in older carpeting and the problems with keeping carpet clean.

The school nurse worked with the town's health agent and Board of Health to develop a system to identify environmentally sensitive students (including those with asthma) and faculty (through incidence reports). This system would be used to keep track of illnesses among this group, and would be used if the school ever experienced a situation where the indoor air environment was compromised. Such a situation did come up later, after a fire in one of the schools. Those who were environmentally sensitive were kept home until the smoke and soot had been removed from the building.

By initiating a comprehensive system of dealing with the problems identified in the schools, the town avoided some of the problems typically associated with sick schools. Their fast response to the initial consultant's results (the mouse dying) helped them avoid the lack of trust that often keeps administrations and staff/parents from working cooperatively towards a solution. The work done by the school nurse, and the cooperation between the school and the Board of Health continues to keep sensitive individuals safe and healthy.

Recently, the parent who filed the initial complaint about the indoor air quality recommended the school system for a national award for its handling of the indoor air quality issues at the school. The school system won the award, and received it in late 1996.

Appendix 2

Useful Internet Web Sites

Indoor Air Quality

Environmental Protection Agency indoor air quality page
http://www.epa.gov/iaq/index.html

NIOSH indoor air quality survey - http://www.cdc.gov/niosh/ieqwww.txt

For an online copy of Tools for Schools - http://www.envirocenter.com

http://www.envirosense.org

Facility Managers page, "search" for indoor air quality for pertinent documents
http://www.facilitiesnet.com

American Society of Heating, Refrigeration, and Air-Conditioning Engineers page, "search" for indoor air quality for pertinent documents - http://www.ashrae.org

Toxics Use Reduction for Schools

Merrimack College's Microscale Chemistry Center - http:www.silvertech.com/microscale

Material Safety Data Sheets

Internet chemistry resources - databases:

http://www.rpi.edu/dept/chem/cheminfo/chemres

gopher://biochemistry.bioc.cwru.edu/7sc%3a/database/utahmsds.mnu

http://drambuie.lanl.gov/cgi-bin/internal/ohsqform.pl

http://home1.gte.net/msdsrx/index.html

gopher://atlas.chem.utah.edu/11/

National Toxicology Program - http://ntp-server.niehs.nih.gov/

University of Virginia toxic chemical fact sheets
gopher://ecosys.drdr.virginia.edu/11/library/gen/toxics

Vermont SIRI MSDS Gopher - http://siri.org

Vermont SIRI MSDS Gopher - search by manufacturer or product name
http://hazard.com/msds/index.html

Agency for Toxics Substances and Disease Registry (ATSDR) - TOXFAQS
http://atsdr1.atsdr.cdc.gov:8080/toxfaq.html

Agency for Toxics Substances and Disease Registry (ATSDR)
Hazardous Substances Release/Health Effects Database
http://atsdr1.atsdr.cdc.gov:8080/hazdat.html

Appendix 3

Results of Questionnaire sent after the OTA Indoor Air Quality In Public Schools Conferences of January and March 1996

- Of the 37 Questionnaires received 29 people attended the conference.

- Ten (10) attendees represented schools which had Indoor Air Quality committees prior to attending the conference. Nine (9) attendees established an indoor air quality committee after attending the conference and 6 attendees are currently trying to establish one.

- For those who have established or are currently trying to establish a committee, a variety of people took the lead including the Principal, the Assistant Superintendent, staff, the administration, the Business Manager, the teachers, the Senior Custodian, and the Director of Buildings and Grounds.

- For those who established a committee the attendees indicated the following factors were involved:

  information learned from the conference (10)
  "tools for schools" manual guidelines (9)
  self initiated (9)
  encouragement from school staff (11)
  encouragement from Principal (10)
  encouragement from School Committee (5)
  encouragement from parents (4)

  participation of school staff (13): {teachers (6), nurses (4), custodians (3) administration(2), maintenance personnel (2), Superintendent (1), School Council (1), voc tech teachers (1),
  Building Commission (1), Board of Health (1)]
  participation of Principal (12)
  participation of School Committee (3)
  participation of School Council (1)
  participation of parents (3)

  reactions to a complaint from teachers (14)
  reactions to a complaint from Principal (5)
  reactions to a complaint from parents (14)
  reactions to a complaint from students (14)
  reactions to a complaint from others (2)

- For those who have established an Indoor Air Quality committee the following activities were pursued:
  10 performed school walkthroughs by school personnel
  8 performed school walkthroughs by a state agencies
  9 performed school walkthroughs by a paid consultants
  10 identified indoor air quality problems
  9 started keeping records of health effects thought to be associated with poor IAQ
  3 have been educating the committee by housekeeping, school newspaper, or

distribution of materials
10 corrected indoor air quality problems by:
improving ventilation by turning on fans, moving items blocking fans, increasing air flow, rebalancing system, or changing filters (6)
fixing roof leaks which caused dampness and mildew
locating an old drainage pit
housekeeping improvements and equipment maintenance
ending of temporary construction

- For those who have not formed a committee the following are factors:
  no immediate crisis (12)
  need more info (3)
  need participation of Principal, custodial staff, or other school administration (3)
  need approval of facility department, Business Manager, or the Superintendent (4)
  lack time in their schedule (6)
  lack money (4)
  lack expertise (5)
  afraid to call attention until extent of problem is known (1)

- 17 have fully read "tools for schools" and 16 have partially read it

- 19 have passed the "tools for schools" manual on to:
  the Principal or Assistant Principal (5)
  the Administrative Intern (1)
  the Safety Coordinator (1)
  the School Committee (2)
  the Business Manager (1)
  the Maintenance Director (2)
  Maintenance Personnel (1)
  the Maintenance Supervisor (1)
  the Central Office (1)
  the School Nurse (4)

- The parts of the "tools for schools" manual that were found useful:
  checklists (22)
  descriptions of potential IAQ problems (25)
  descriptions of health effects (11)
  procedures for record keeping by school nurses (10)
  how to organize an IAQ committee and assign roles (7)
  how to deal with IAQ complaints (16)
  strategies for dealing with the "politics" of IAQ complaints (8)
  how to incorporate IAQ concerns into new construction bids (4)
  problem solving wheel (10)

- Other information or assistance needed to establish an IAQ committee:
  future meetings (2)

time (1)
how to handle communications while investigating (1)
IAQ hotline (1)
staff and money (1)
inservice for custodial staff (1)

Appendix 4

School Hazardous Materials Management
List of Information Available
January 1999

Laboratory Safety/pollution Prevention

__ Understanding Material Safety Data Sheets (MSDS), Your right to know
__ MA Right to Know Fact Sheet
__ List of High Risk Chemicals courtesy of ChemSafe Consultants
__ newspaper/internet articles on hazardous materials issues in schools (accidents, etc.)
__ Reduction of Hazardous Waste from HS Chemistry Labs - NC
__ List of incompatible chemicals - helpful for setting up storage areas
__ A Parent's Guide to Curriculum-Based Chemicals in Schools
__ EPA Pollution Prevention Guide for Educational Institutions
__ MSPCA regulations regarding keeping of live animals in class
__ Fundamentals of Lab Safety - Chapter 9 - Ventilation
__ American Chemical Society/Lab Safety Workshop flyers
__ 101 Ways to reduce hazardous waste in the lab
__ Alaska Health Project: Waste Reduction Assistance Program onsite consultation audit report for a high school
__ Recognition and Handling of Peroxidizable Compounds: National Safety Council
__ Maine Department of Education regulations on Purchase and Storage of chemicals in Maine public schools
__ Laboratory Safety Audit checklist (to be used for self auditing of laboratories)
__ Chemical Hazards On the Job: Your Right to Know (Massachusetts Right to Know Law booklet for workers)
__ List of accidents which have occurred in school labs courtesy of James Kaufman of Laboratory Safety Workshops
__ Laboratory Safety Manual for U-MA Amherst
__ Hazardous Materials Identification System (HMIS) of labeling
__ Explosive Chemicals List
_ How Toxic is Toxic?
__ A Summary of Requirements for Small Quantity Generators of Hazardous Waste
__ Is Your Lab a Safe Place to Work? Laboratory Safety Workshop Scorecard
__ List of Acutely Hazardous Wastes
__ MA General Law requiring safety glasses in school labs
__ Specifications for Safety Showers in labs
__ Specifications for Eyewash Stations in labs
__ Purchasing information for eyewash stations and safety showers

__ Information on space requirements in school science labs
__ Flynn Scientific Safety Contract for students
__ Hazardous Waste Management - A Guidebook for Schools
__ Information on silver recovery firms for photographic waste
__ Information on Merrimack College and the National Microscale Chemistry Center
__ Information on the Art and Creative Materials Institute, Inc. nontoxic art materials
__ Guide for Glove Compatibility in science labs
__ Department of Public Health regulations for Infectious Waste
__ Article "Chemistry, Courtrooms, and Common Sense"
__ Article on Fume Hoods in the lab
__ California No Waste Lab Manual for Educational Institutions
__ Improving Chemical Management in Massachusetts Public High School Science Laboratories: a thesis prepared by students at Tufts University
__ booklet: Finding your way through DEP (Ma Department of Environmental Protection)
_ Generic chemical hygiene plan for high school labs
_ Selected microscale chemistry book table of contents
_ 1991 National Fire Protection Association rules on labs
__ information on bench top fume hoods for science departments
__ Toxics Use Reduction Plan: Smith Vocational and Agricultural HS
__ Smith Vocational and Agricultural HS: Curriculum: Embracing the four R's (reduce, replace, recycle, reuse) - a curriculum for teaching about hazardous materials
__ Project CLEEN: An Environmental Impact Analysis Targeting Areas for Pollution Prevention at Salem County Vocational Technical Schools by New Jersey Technical Asst. Program
__ Laboratory Waste Minimization and Pollution Prevention: a Guide for Teachers by Battelle Pacific Northwest Laboratories

<u>Integrated Pest Management</u>

__ Large package of information on Integrated Pest Management (IPM) and how to implement a program at schools
__ Integrated Pest Management Kit for Building Managers
__ Proceedings from the Sept. 1996 conference "Structural Integrated Pest Management"

<u>Indoor Air Quality</u>

__ EPA's "Tools for Schools" guide to improving indoor air quality in schools
__ EPAs Indoor Air Quality Information Clearinghouse
__ EPAs Survey of Indoor Air Quality Diagnostic and Mitigation Firms (list of consultants)
_ Asthma and Allergy Foundation Winter 1996 Bulletin
_ School Construction Project Sequence: when you input for good indoor air quality

_ Build Boston 1995 - workbook from an indoor air quality session
_ School nurse sample medical tracking program courtesy of Duxbury schools
__ list of IAQ School Facilities Documents available from Maryland Department of Education

(**highly recommended**)
__ MassCOSH bulletin on carpeting and indoor air quality (MA Coalition for Occupational Safety and Health)
__ information on air purifiers for art departments
__ article on explosion caused by indoor air contaminants
__ Information on the services provided by the Department of Labor and Industries, Division of Occupational Hygiene (State agency that provides free IAQ consultations)
__ Information on the services provided by the Department of Public Health (State that provides free IAQ consultations)
__ Information on the health affects of mold
__ Boscawen NH, Designing a school for good indoor air quality. Article about the school from "School Planning and Management" magazine, and a brochure from the architects
__ School Environmental Assessment Checklist for Parents, Health Survey for Children
__ Articles on poor IAQ in various Massachusetts' schools

For copies of the listed documents, send this form or your written request to:

Rick Reibstein
Massachusetts Office of Technical Assistance
100 Cambridge Street, Room 2109
Boston, MA 02202
Fax 617-626-1060